

REMARKS

Claims 1-31 are currently pending in the application. Claims 18-31 were withdrawn from consideration by the Examiner in the Office Action dated October 11, 2006. By this amendment, no claims are amended, added, or canceled. Reconsideration of the rejected claims in view of the following remarks is respectfully requested.

Allowed Claims

Applicants appreciate the indication that claims 2, 5, 8, 13, 16, and 17 contain allowable subject matter. However, Applicants submit that all of the claims are in condition for allowance for the following reasons.

35 U.S.C. §102 Rejection

Claims 1, 3, 6, and 9-12 were rejected under 35 U.S.C. §102(e) for being anticipated by U.S. Patent Application Publication No. 2002/0061615 issued to Kawagoe et al. ("Kawagoe").¹ This rejection is respectfully traversed.

To anticipate a claim, each and every element as set forth in the claim must be found, either expressly or inherently described, in a single prior art reference. See MPEP §2131. Applicants submit that Kawagoe does not contain each and every feature of the claimed invention.

The present invention generally relates to a semiconductor device and method of manufacture and, more particularly, to a semiconductor device and method of manufacture

¹ Applicants note that Paragraph 6 of the Office Action states that claims 1 and 3 are rejected under §102(e) in view of Kawagoe. However, claims 1, 3, 6, and 9-12 are addressed in the explanation of the rejection. Therefore, it will be assumed that claims 1, 3, 6, and 9-12 are rejected under §102(e) in view of Kawagoe.

which imposes tensile and compressive stresses in the device during device fabrication. In non-limiting exemplary implementations of the invention, a high temperature thermal mixing step is provided such that a shallow trench isolation can relax and facilitate the relaxation of islands.

Claim 1 recites:

1. A method of manufacturing a structure, comprising the steps of:
 - forming shallow trench isolation (STI) in a substrate;
 - providing a first material on the substrate;
 - providing a second material on the substrate;
 - mixing the first material and the second material into the substrate by a thermal anneal process to form a first island and second island at a nFET region and a pFET region, respectively; and
 - forming a layer of material on the first island and the second island having a lattice constant different than the first island and the second island,
 - wherein the STI relaxes and facilitates the relaxation of the first island and the second island.

The Examiner asserts that Kawagoe discloses all of the features of claim 1 in FIGS. 20-24 and Paragraphs 0084, 0172, 0173, and 0174. Applicants respectfully disagree. Kawagoe does not contain all of these features, and, therefore, does not anticipate the claimed invention.

Kawagoe discloses, in FIGS. 20-24, a method for fabricating a semiconductor device. The method comprises providing a substrate 2W composed of p-type Si single crystal and doped with an impurity such as boron. An epitaxial layer 2E is formed on the substrate, the layer 2E being composed of p-type Si single crystal doped with an impurity (e.g., boron) in a concentration lower than the impurity concentration of substrate 2W (paragraphs 0153, 0154, 0169, and 0170). A region of the epitaxial layer 2E is doped with phosphor, and a different region of the layer 2E is doped with boron. (Paragraphs 0172 and 0173). The device is subjected to an annealing treatment to form the p-well 6p and the n-well 6n. Subsequent to the

annealing, a pad-oxide film 12c is formed, after which a field insulating film 3 is formed (paragraphs 0176 and 0177). Lastly, an nMOS 4N and pMOS 4P are formed.

However, Kawagoe does not disclose providing a first material on the substrate, and providing a second material on the substrate, as recited in claim 1. Contrary to the Examiner's assertion, doping the epitaxial layer 2E with phosphor and boron (as described in paragraphs 0172 and 0173) does not constitute providing a first material on the substrate and providing a second material on the substrate. Doping, as disclosed by Kawagoe and as known in the art, comprises implantation of ions within the substrate. In exemplary non-limiting embodiments of the instant invention, however, a material is provided on (*e.g.*, grown or deposited on) the exposed surface of the substrate. Thus, *doping*, as disclosed by Kawagoe, does not constitute *providing on*, as recited in claim 1.

Furthermore, Kawagoe does not disclose forming a layer of material on the first island and the second island, as recited in claim 1. Contrary to the Examiner's assertion, gate electrode 4Pd does not constitute a layer of material formed over the first island *and* second island. As is clearly seen in FIG. 23, gate electrode 4Pd is only disposed over the n-well portion 6n of the substrate, and is not formed over the p-well portion 6p. Thus, gate electrode 4Pd is only formed over a first island portion, and not over a second island portion. Therefore, Kawagoe does not disclose forming a layer of material on the first island and the second island.

Even further, Kawagoe does not disclose forming a layer of material on the first island and the second island having a lattice constant different than the first island and the second island, as recited in claim 1. Even assuming *arguendo* that gate electrode 4Pd constitutes a layer or material formed over the first island and second island, which Applicants do not concede, there is no teaching whatsoever that the gate electrode material 4Pd has a lattice constant

different than the first island and the second island. Kawagoe is completely silent as to the lattice constants of the gate electrode 4Pd, n-well 6n, and p-well 6p. Therefore, Kawagoe does not disclose forming a layer of material on the first island and the second island having a lattice constant different than the first island and the second island.

Additionally, Kawagoe does not disclose the STI relaxes and facilitates the relaxation of the first island and the second island, as recited in claim 1. The Examiner asserts that field insulating film 3 is an STI. The Examiner then reasons that, because the field insulating film 3 is composed of SiO_2 , it has the same characteristics as the STI disclosed in the instant application and performs the features recited in claim 1. Applicants respectfully disagree.

In non-limiting exemplary embodiments of the invention, the STI is formed in the substrate before the annealing process. As such, the STI is at least partially exposed to the high temperature of the annealing process. Due to the high temperature of the annealing process, the STI can relax and facilitate relaxation of the first and second islands. Kawagoe, however, does not disclose such relaxing. In Kawagoe, the field insulating film 3 is formed *after* the annealing step. That is, the wafer 2W is subjected to an annealing treatment to form the p-well 6p and n-well 6n (paragraph 0174), and, only after this annealing, is the field insulating film 3 formed (paragraph 0177). As such, the field insulating film 3 does not experience the high temperatures of the annealing step, and does not undergo a relaxation. Therefore, Kawagoe does not disclose the STI relaxes and facilitates the relaxation of the first island and the second island, as recited in claim 1.

Because Kawagoe does not contain at least the above noted features of claim 1, Kawagoe does not anticipate the claimed invention and the rejection should be withdrawn.

Applicants submit that claims 3, 6, and 9-12 are allowable at least for the reason that these claims depend from allowable independent claim 1 and because these claims recite additional features that further define the present invention. Moreover, Applicants submit that Kawagoe does not contain many of the features of these dependent claims.

For example, Kawagoe does not disclose the first material and the second material are deposited on the substrate prior to the mixing step, as recited in claim 11. As discussed above, Kawagoe disclose that the impurity ions (i.e., boron and phosphor) are *doped into* the layer 2E. Kawagoe does not disclose that any material is *deposited on* the substrate.

Additionally, Kawagoe does not disclose the first material and the second material are grown on the substrate prior to the mixing step, as recited in claim 12. As discussed above, Kawagoe disclose that the impurity ions (i.e., boron and phosphor) are *doped into* the layer 2E. Kawagoe does not disclose that any material is *grown on* the substrate.

Accordingly, Applicants respectfully request that the rejection over claims 3, 6, and 9-12 be withdrawn.

35 U.S.C. §103 Rejection

Claim 4 was rejected under 35 U.S.C. §103(a) for being unpatentable over Kawagoe in view of U.S. Patent Application Publication No. 2004/0005750 issued to Chen et al. (“Chen”). Claims 7 and 15 were rejected under 35 U.S.C. §103(a) for being unpatentable over Kawagoe in view of U.S. Patent Application Publication No. 2004/0253776 issued to Hoffman et al. (“Hoffman”). Claim 14 was rejected under 35 U.S.C. §103(a) for being unpatentable over Kawagoe in view of Chen and Hoffman. These rejections are respectfully traversed.

The Examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. MPEP §2142.

Claim 4

The Examiner asserts that Kawagoe discloses all of the features of claim 4 except for growing a layer of Si material on the first island and the second island. The Examiner further asserts that Chen teaches this feature, that it would have been obvious at the time the invention was made to modify Kawagoe in view of the teachings of Chen, and that the resulting combination contains every feature of the claimed invention. Applicants respectfully disagree.

As discussed above, Kawagoe does not teach or suggest: (1) providing a first material on the substrate and providing a second material on the substrate; (2) forming a layer of material on the first island and the second island; (3) the layer of material having a lattice constant different than the first island and the second island; or (4) the STI relaxes and facilitates the relaxation of the first island and the second island. Chen does not compensate for the deficiencies of Kawagoe with respect to claim 1. That is, Chen does not teach or suggest any of the above-noted features identified as lacking in Kawagoe. Instead, Chen discloses a method for gate formation on a substrate, and makes no mention of providing a first material on the substrate, providing a second material on the substrate, and forming a layer of material on the first island and the second island having a lattice constant different than the first island and the second island,

wherein the STI relaxes and facilitates the relaxation of the first island and the second island. Therefore, no proper combination of the applied references teaches or suggests all of the features of claim 4.

Accordingly, Applicants respectfully request that the rejection over claim 4 be withdrawn.

Claims 7 and 15

The Examiner asserts that Kawagoe discloses all of the features of claim 7 except for the Si material being placed in a tensile stress on the first island and placed in a compressive stress on the second island. The Examiner further asserts that Hoffman teaches this feature, that it would have been obvious at the time the invention was made to modify Kawagoe in view of the teachings of Hoffman, and that the resulting combination contains every feature of the claimed invention. Applicants respectfully disagree.

Applicants note that claim 7 depends from claim 4. The rejection of claim 7 in view of Kawagoe and Hoffman does not address the features of claim 4. Therefore, the Examiner has failed to establish a *prima facie* case of obviousness with respect to claim 7 and the rejection should be withdrawn for at least this reason.

In any event, as discussed above, Kawagoe does not teach or suggest: (1) providing a first material on the substrate, and providing a second material on the substrate; (2) forming a layer of material on the first island and the second island; (3) the layer of material having a lattice constant different than the first island and the second island; or (4) the STI relaxes and facilitates the relaxation of the first island and the second island. Hoffman does not compensate for the deficiencies of Kawagoe with respect to claim 1. That is, Hoffman does not teach or suggest any of the above-noted features identified as lacking in Kawagoe. Instead, Hoffman discloses

forming an n-well and p-well by doping (paragraph 0017), and makes no mention of providing a first material on the substrate, providing a second material on the substrate, and forming a layer of material on the first island and the second island having a lattice constant different than the first island and the second island, wherein the STI relaxes and facilitates the relaxation of the first island and the second island. Therefore, no proper combination of the applied references teaches or suggests all of the features of claim 7.

Claim 15 recites the first island has a lattice constant $a \geq a_{Si}$ and the second island has a lattice constant $a \leq a_{Si}$. Applicants note that the rejection presented in paragraphs 13-16 of outstanding Office Action do not address these features. Therefore, the Examiner has failed to establish a *prima facie* case of obviousness with respect to claim 15 and the rejection should be withdrawn for at least this reason. In any event, Applicants submit that neither Kawagoe nor Hoffman teaches or suggests the first island has a lattice constant $a \geq a_{Si}$ and the second island has a lattice constant $a \leq a_{Si}$. Therefore, the applied references do not teach or suggest all of the features of claim 15.

Accordingly, Applicants respectfully request that the rejection over claims 7 and 15 be withdrawn.

Claim 14

The Examiner admits that Kawagoe does not teach or suggest epitaxially growing Si, or that Si material is placed in tensile stress on the first island and placed in a compressive stress on the second island. The Examiner further asserts that Chen teaches epitaxially growing Si, and that Hoffman teaches that Si material is placed in tensile stress on the first island and placed in a compressive stress on the second island. The Examiner asserts that it would have been obvious at the time the invention was made to modify Kawagoe in view of the teachings of Chen and

Hoffman, and that the resulting combination contains every feature of the claimed invention.

Applicants respectfully disagree.

Claim 14 recites the layer of material includes selectively growing an Si epitaxial layer on the first island and the second island, the Si epitaxial layer having a different lattice constant than the first island and the second island such that the selectively grown Si epitaxial layer will strain tensilely and compressively on the first island and the second island, respectively.

Notwithstanding the Examiner's above-noted assertions, Applicants submit that the rejection does not address the features of the claim. That is, the explanation of the rejection does not address how the applied references teach or suggest the Si epitaxial layer having a different lattice constant than the first island and the second island. Therefore, the Examiner has failed to establish a *prima facie* case of obviousness with respect to claim 14 and the rejection should be withdrawn for at least this reason.

In any event, as discussed above, Kawagoe does not teach or suggest: (1) providing a first material on the substrate, and providing a second material on the substrate; (2) forming a layer of material on the first island and the second island; (3) the layer of material having a lattice constant different than the first island and the second island; or (4) the STI relaxes and facilitates the relaxation of the first island and the second island. Hoffman and Chen do not compensate for the deficiencies of Kawagoe with respect to claim 1. Therefore, no proper combination of the applied references teaches or suggests all of the features of claim 14.

Accordingly, Applicants respectfully request that the rejection over claim 14 be withdrawn.

CONCLUSION

In view of the foregoing remarks, Applicants submit that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicants hereby make a written conditional petition for extension of time, if required. Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 09-0458.

Respectfully submitted,
Dureseti CHIDAMBARRAO



Andrew M. Calderon
Reg. No. 38,093

December 20, 2006
GREENBLUM & BERNSTEIN, P.L.C.
1950 Roland Clarke Place
Reston, VA 20191
(703) 716-1191